# Bioenergy and Agriculture: Promises and Challenges

## Bioenergy and the Poor

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Biomass is a primary source of energy for close to 2.4 billion people in developing countries. Easily available to many of the world's poor, biomass provides vital and affordable energy for cooking and space heating. Although widespread use of traditional and inefficient biomass energy in poor countries has been linked to indoor air pollution as well as to land degradation and attendant soil erosion, biomass-based industries are a significant source of jobs and income in poor rural areas with few other opportunities

The share of biomass energy in total energy consumption varies across developing countries, but generally the poorer the country, the greater its reliance on traditional biomass resources (see figure). Biomass has considerable potential to become more important in total energy consumption, and this growth could have significant impacts, both positive and negative, on agriculture and the poor. This brief delineates two broad categories for bioenergy development—the exploitation of existing agricultural wastes and the establishment of energy plantations—and suggests high-priority steps for developing bioenergy in ways that benefit the poor.

### USE OF EXISTING AGRICULTURAL WASTES

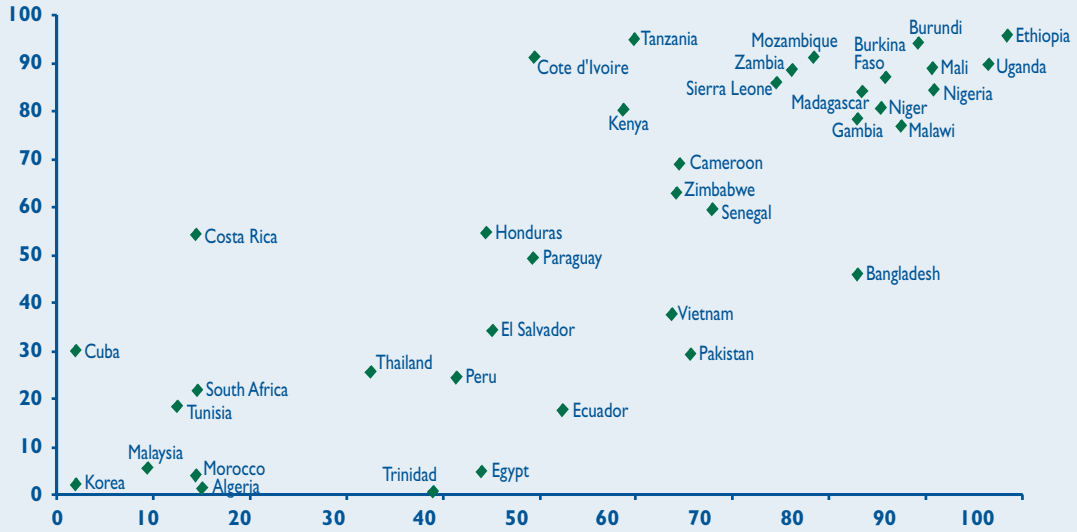
The efficient exploitation of existing agricultural wastes presents significant potential for developing bioenergy without unduly disrupting existing agricultural practices and food production or requiring new land to come into production. Some of the most common crop wastes suitable for bioenergy development include sugarcane bagasse, sisal waste, coffee husks, rice husks, maize cobs, and banana leaves. Unlike many other crop wastes, these waste products are generated during agroprocessing and are rarely returned to the field. Consequently, use of such agricultural wastes for energy generation is unlikely to have a detrimental impact on soil management and food production and could potentially be an additional source of revenue for the poor.

The use of existing agricultural wastes can be further subdivided into the following categories:

- **Centralized energy generation from centralized agricultural waste that is currently not utilized efficiently.** Some industries and sectors, such as sugar factories, use agricultural wastes produced by their processing activities to generate heat and electricity for their own use and for sale. Improving the efficiency of energy production from these wastes could deliver significant benefits to the industries and other stakeholders, including the poor, if the appropriate regulatory and revenue-sharing mechanisms are in place. For example, smallholder cane farmers in Mauritius share the revenues from large-scale bagasse-based cogeneration plants (which meet close to 40 percent of the country's electricity needs).

- **Centralized energy generation from decentralized agricultural waste production.** For effective use of decentralized wastes generated at the farm level during harvesting (like banana leaves), an efficient system for collection, transportation, storage, handling, and fuel preparation is needed. Without such a system, the cost of centralization could limit the potential for energy production. In cases where a cost-effective waste centralization system is in place, the poor can benefit directly from the use of agricultural wastes for energy generation.

**Poverty and Traditional Energy Use**




Sources: International Energy Agency (IEA), *World Energy Outlook 2000* (Paris: 2000); United Nations Development Programme (UNDP), *Human Development Report: 2003* (New York: 2003).

- **Decentralized energy generation from decentralized agricultural wastes.** Poor, small-scale farmers with substantial agricultural wastes can engage in decentralized energy generation, mainly for their own consumption, but the energy service they obtain from these wastes is often of poor quality. Moreover, in areas where agricultural wastes are typically used to enrich the soil, using them for energy can be detrimental to the long-term health of soil and may even contribute to increased rural poverty. One option that has proven successful in a number of developing countries is household, community, or institutional biogas production. This technology not only provides clean energy for household, community, or institutional use, but its by-product is a rich organic manure that can be recycled in fields to reduce the need for chemical fertilizer and pesticides.

## ENERGY PLANTATIONS

Dedicated energy plantations are not yet widespread in developing countries, so there is little empirical basis for evaluating their benefits for the poor. Nonetheless, to better understand how energy plantations might affect the poor, it is useful to distinguish between direct and indirect impacts.

Energy plantations have direct impacts primarily on nearby rural people. Negative impacts include possible dispossession of land among the poor in areas with insecure land tenure, with the result that poverty and food insecurity may increase. Without appropriate, sensitive, and equitable management, large-scale modern biomass energy development can lead to further marginalization of the rural poor. It is, however, possible that the growth and development of these technologies could lead to increased incomes for the poor (such as smallholder sugar farmers) if a well-designed revenue-sharing scheme is established. Positive impacts could also include potential increases in employment (in agriculture or bioenergy production). Management of energy plantations by individual households or community groups can yield significant benefits to the poor. Community-managed energy plantations are particularly attractive, since they allow smallholder farmers to join together and produce energy crops with the advantages of large-scale farming. Another benefit of this approach is the creation of local employment opportunities in the planting, harvesting, and processing of energy crops. Several developing countries are piloting small- and medium-scale energy plantations using a variety of crops, the most common being *Jatropha*. At the local level, small- and medium-scale energy plantations can contribute to poverty reduction through increased incomes for small-scale farmers.

Indirectly, energy plantations affect all types of poor people, including the urban poor. On the positive side, these impacts include potential lower energy costs (and associated lower transportation costs, assuming that the bioenergy resources are local) and increased employment from urban-based bioenergy processing plants and distribution enterprises. On the other hand, higher costs of food might arise where there is competition between food and bioenergy for land or water. Whether these positive and negative impacts result in a net gain or loss for poor people will depend in part on household budget shares for energy and food, as well as the importance of the jobs and enterprises created by the bioenergy subsector.

Options for limiting the competition for land between food and fuel include increasing food production on current agricultural lands and establishing large tree plantations on low-potential and degraded lands not currently used for food. The trade-offs presented by dedicated energy plantations have to be carefully evaluated to ensure optimum use of existing land resources without endangering food supplies.

Existing studies of the impact of dedicated energy plantations on the poor and on food security are still largely speculative. Additional research is needed to better predict the net impacts, which are likely to vary by type of region and household and to depend on the extent to which a viable and competitive bioenergy sector is established.

## PRIORITIES FOR DEVELOPING A PRO-POOR BIOENERGY SECTOR

For developing countries with a large number of poor people reliant on agriculture, the first priority should be given to effective use of existing agricultural wastes for energy generation. This option has the least adverse impact on the poor and could provide additional revenue for poor rural communities. It requires, however, establishing effective revenue-sharing mechanisms that ensure that the higher revenues from the exploitation of agricultural wastes are shared in an equitable fashion and flow to all stakeholders, including low-income farmers. It also requires enacting a legal and regulatory framework that allows for the development of modern agro-waste-based bioenergy and that provides, among other incentives, access to the power grid and transport fuel market. In some cases, mechanisms for efficient centralization of agricultural wastes would need to be in place.

Once developing countries have optimized the use of existing agricultural wastes for energy generation and put in place adequate revenue-sharing, regulatory, and policy frameworks, they can consider the option of dedicated energy plantations, while carefully balancing any associated trade-offs between food security and energy generation. Fortunately, the technical, regulatory, and policy expertise needed to promote an equitable agricultural waste energy industry also provides, in many cases, the skills needed to develop and nurture a sustainable dedicated energy plantation sector that does not adversely affect the poor or decrease food security. ■

**For further reading see S. Karekezi, K. Lata, and S.T. Coelho, "Traditional Biomass Energy: Improving Its Use and Moving to Modern Energy Use," thematic background paper for the 2004 International Conference for Renewable Energies (Bonn, Germany: Secretariat for the International Conference for Renewable Energies, 2004); E. D. Larson and S. Kartha, "Expanding Roles for Modernized Biomass Energy," *Energy for Sustainable Development* 4, no. 3 (Bangalore, India: International Energy Initiative, 2000); UNDP (United Nations Development Programme), *Energy and the Challenge of Sustainability* (New York: 2000).**

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